



Exposure Limitations

The air contaminant rules set permissible exposure limits (PEL) for approximately 600 substances. PELs set by these rules include:

- The time-weighted average (TWA), which represents the employee's average airborne exposure to hazardous substances which shall not be exceeded in any eight-hour work shift of any 40-hour work week;
- The short-term exposure limit (STEL), which represents the employee's 15-minute TWA exposure, which shall not be exceeded at any time during a work day unless another time limit is specified for the contaminant; and
- A ceiling limit, which is the employee's exposure that shall not be exceeded during any part of the workday. If instantaneous monitoring is not feasible, the ceiling shall be assessed as a 15-minute, TWA exposure that shall not be exceeded during any part of the workday.



Permissible Exposure Limits for Some Commonly Used Chemicals		
Chemical	Time-Weighted Average	Short-Term Exposure Limit
Acetone	750 ppm	1,000 ppm
2-butoxyethanol	25 ppm	n/a
Toluene	100 ppm	150 ppm
1,1,1-Trichloroethane	350 ppm	450 ppm
Xylene	100 ppm	150 ppm

Employee Exposure

As an employer who uses hazardous chemicals in the workplace, you should evaluate your employees' potential exposure to these chemicals. Key elements of a hazard evaluation will provide you with the knowledge to determine which materials must be monitored for exposure purposes. This evaluation may be coordinated with your facility's pollution prevention efforts. Steps that should be considered in the evaluation include:

- Determining the physical, chemical, and toxicological properties of the hazardous material.



- Quantifying the amount of product that is used and the rate at which gases or vapors are generated.
- Determining the length of exposure.
- Considering the decomposition of products and other types of hazards, such as skin absorption or ingestion.
- Evaluating the location of the hazard and existing engineering controls.
- Seasonal considerations. Volatile compounds will produce more vapors as the temperature of the workplace increases during summer months. Dilution ventilation during cold months typically decreases as buildings are closed up to minimize heat loss.

Monitoring

The best method of evaluating employee exposure to hazardous chemicals is achieved by conducting personal monitoring. Personal monitoring means the sample is collected as close as possible to the exposed employee's breathing zone.

Area monitoring (collecting the sample from an area of the plant where employees are exposed to hazardous chemicals) can be conducted in some circumstances to provide general information pertaining to the likelihood of overexposure of employees to regulated permissible exposure limits. However, area monitoring can produce inaccurate results if the sample is not collected from a proper location.

Monitoring of air contaminants can be conducted in a variety of ways. These include:

- Use of direct reading instruments which provides instantaneous or continuous analytical results.
- Use of personal monitoring devices that are either passive or active. Active devices utilize a pump to draw air through some type of collection media. The collection media is then sent to a laboratory for analysis. There are specific, recognized procedures for collection and analysis of air contaminants, which must be followed to ensure reporting of accurate results.
- Use of detector tubes, which are a type of passive or active monitoring device that provides quick, inexpensive, and relatively accurate analysis of contaminant levels in the workplace.

INSafe provides free, professional, on-site assistance to aid employers in evaluating employee exposure to air contaminants. Refer to the Web at www.dol.IN.gov/INSafe.htm or call (317) 232-2688 for assistance.

Engineering Controls

When employee exposures to an air contaminant exceed the permissible exposure limit, the employer must institute available and feasible (i.e., economically, structurally, etc.) engineering controls to reduce exposures below the PEL. If engineering controls are unable to reduce exposures to below the PEL, they must still be used to attain the lowest exposure levels feasible. Types of engineering controls may include:

- Bringing in large volumes of fresh air to dilute the concentrations of hazardous material, commonly referred to as dilution ventilation.
- Use of local exhaust ventilation to capture and remove the hazardous material at its point of emission or source. Use of filters, cyclones, absorbents, and scrubbers may be necessary components of such a ventilation system. These methods are used to capture the contaminant in the exhausted air prior to venting the air to the outdoor environment, or recirculating some or all of the air back into the workplace.
- Construct an enclosure around the employee or the process that uses the hazardous material or generates noise.

Administrative Controls and Personal Protective Equipment

If engineering controls do not reduce the exposures below the permissible exposure limit, you must rely on administrative controls and personal protective equipment (PPE) to reduce exposures. Administrative controls are work practices or policies instituted by the employer to reduce employee exposure to air contaminants. Many of the water and air pollution prevention strategies addressed in previous chapters are also effective controls for your employees' exposures to workplace contaminants.

The last line of defense against airborne contaminants is PPE. This control measure is not considered as effective as engineering controls because the hazard still exists, and you are relying on the employee to properly use the PPE to prevent exposure. Types of PPE include respirators, hearing protection, and chemical protective clothing. PPE should only be used to control exposures to contaminants (including noise):

- When engineering or administrative controls are not available or feasible (or, if these controls are installed but are not enough to reduce exposures below the PEL).
- During the time period that engineering controls are being installed.
- During emergencies.

For more information on personal protective equipment, see Chapter 14.

Lead

The toxic and hazardous substances regulations for lead are found in Title 29 of the Code of Federal Regulations, Section 1910.1025. The standard applies to all occupational exposure to lead, except for those in the construction industry or agricultural operations, which are covered by 29 CFR Part 1928. The employer shall assure that no employee is exposed to lead at concentrations greater than 50 micrograms per cubic meter of air ($50 \mu\text{g}/\text{m}^3$) averaged over an eight-hour period (the permissible exposure limit). If an employee is exposed to lead for more than eight hours in any work day, the permissible exposure limit, as a time-weighted average for that day, shall be reduced according to the following formula:

Maximum permissible limit (in $\mu\text{g}/\text{m}^3$) = 400 divided by the hours worked in the day

When respirators are used to supplement engineering and work practice controls to comply with the PEL and all the requirements of 29 CFR 1910.1025(f) have been met, employee exposure, for the purpose of determining whether the employer has complied with the PEL, may be considered to be at the level provided by the protection factor of the respirator for those periods the respirator is worn. Those periods may be averaged with exposure levels during periods when respirators are not worn to determine the employee's daily time weighted average exposure. For additional information on exposure monitoring, refer to 29 CFR 1910.1025(d).